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Rhode Island Greenhouse Gas Emissions Inventory Executive Summary

Introduction

Recently, the Intergovernmental Panel on Climate Change (IPCC) concluded, "the balance of evidence suggests a discernible human influence on global climate". The most recent worst case climate change impacts projected by the IPCC are an increase in global average temperature of over 10 degrees Fahrenheit and mean sea level rise of almost 3 feet by 2100. Earth's greenhouse effect is a natural phenomenon that helps regulate the temperature of our planet. As the sun heats the Earth some of this heat, rather than escaping back to space, is trapped in the atmosphere by clouds and greenhouse gases (GHG) such as water vapor and carbon dioxide. If all of these GHG were to suddenly disappear, our planet would be 60 degrees (F) colder and uninhabitable.

The RI Department of Environmental Management commissioned Brown University to complete the RI GHG Inventory with EPA funding. This inventory is our baseline for measuring future GHG emissions growth under business as usual and reduction scenarios. The RI GHG Emissions Inventory provides estimates for 1990 and 1996 according to the methodology in *EIIP Document Series, Volume VII: Estimating Greenhouse Gas Emissions*, December 1998 Review Draft. GHG emissions are estimated for carbon dioxide, methane and nitrous oxide in units of Metric Tons of Carbon Equivalent (MTCE) for consistency. The following is a summary of the Rhode Island Greenhouse Gas inventory results. The method for the sector distribution of GHG emissions from electricity consumption is provided here. A complete description of the RI GHG Emissions Inventory is available at www.brown.edu/Research/EnvStudies_Theses/GHG/index.shtml.

Results

Total GHG emissions grew by **11.3%** from 1990 to 1996 with an average annual growth of about **1.9%**.

Fossil fuels dominate the GHG Inventory contributing about 98% in 1990 and 1996. Fossil fuel combustion GHG emissions include carbon dioxide (CO₂) from

- space heating for residential, commercial, and industrial sectors (oil or gas heat)
- industrial processes (boilers, diesel generators, etc.)
- transportation (internal combustion engines)
- electricity generation (coal, oil, or natural gas fired power plants)

Other sources account for about 2% of GHG emissions for 1990 and 1996. Other sources include

- mobile source nitrous oxide (nitrous oxide from catalytic converters during cold starts)
- mobile source methane (methane from internal combustion of fossil fuels)
- forests and forest soils (CO₂ stored from forest growth minus CO₂ released from forest clearing)
- wastewater (methane and nitrous oxide from sewage processing)
- agriculture (methane from domestic animals and manure and nitrous oxide from fertilizer)
- stationary source nitrous oxide (nitrous oxide from fossil fuel combustion)

Note: GHG emissions from solid waste have a negative value of 64,000 MTCE in 1990 (0.8% of 1990 total GHG emissions) and 87,000 MTCE in 1996 (1% of 1996 total GHG emissions) and therefore are a net sink for GHG. However, this sink has not been included in the GHG emissions presented in this summary but is included in the full GHG Inventory report on the aforementioned website.

Figures 1 (a) and (b) illustrates the contribution of GHG emissions as a **percentage of total emissions**. Electricity consumption dominates the GHG emission profile of fossil fuel sources, followed by transportation, residential, commercial, industrial and other sources in decreasing order.

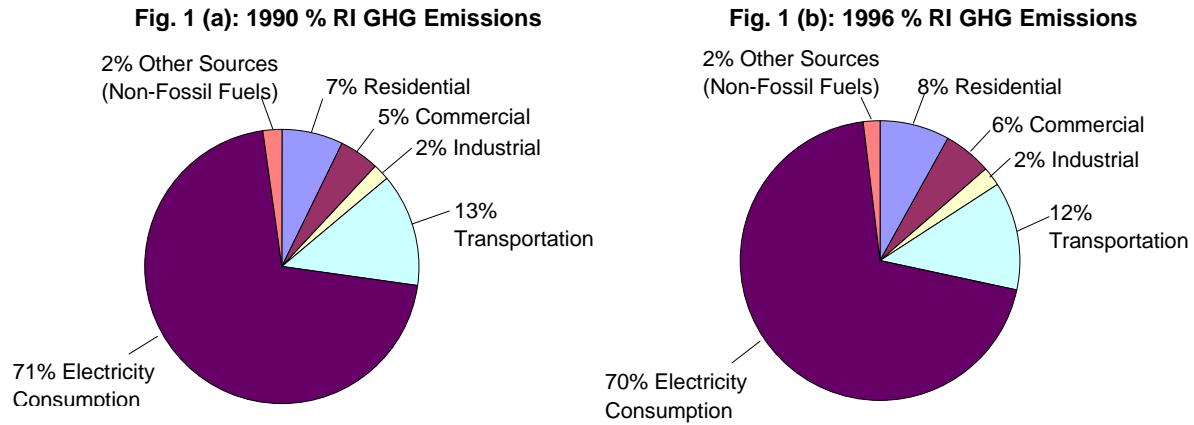
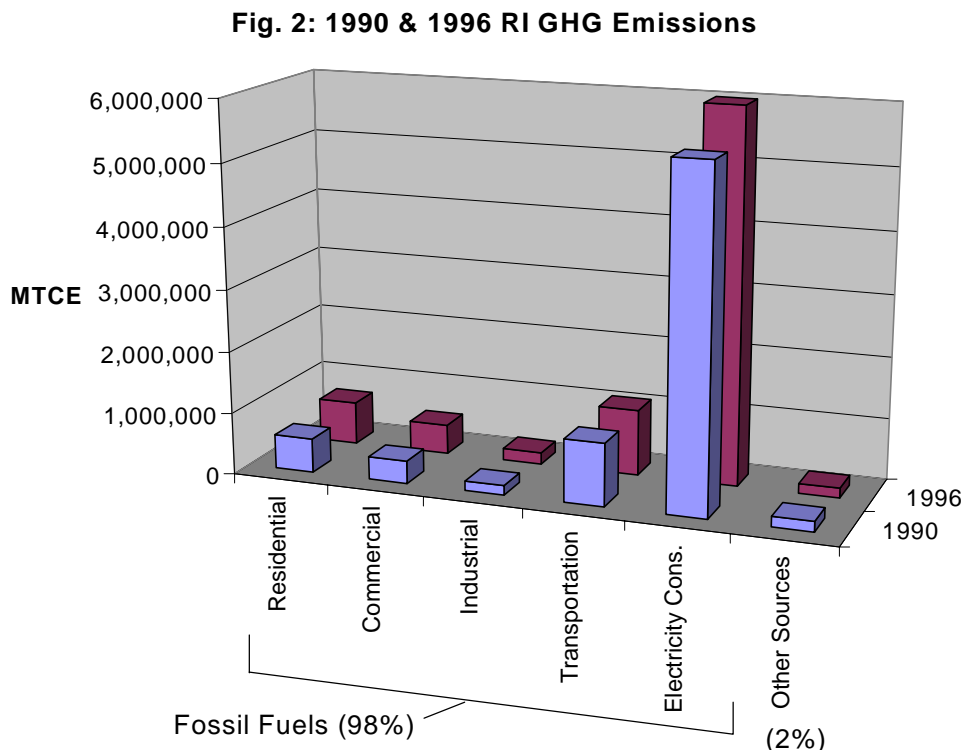


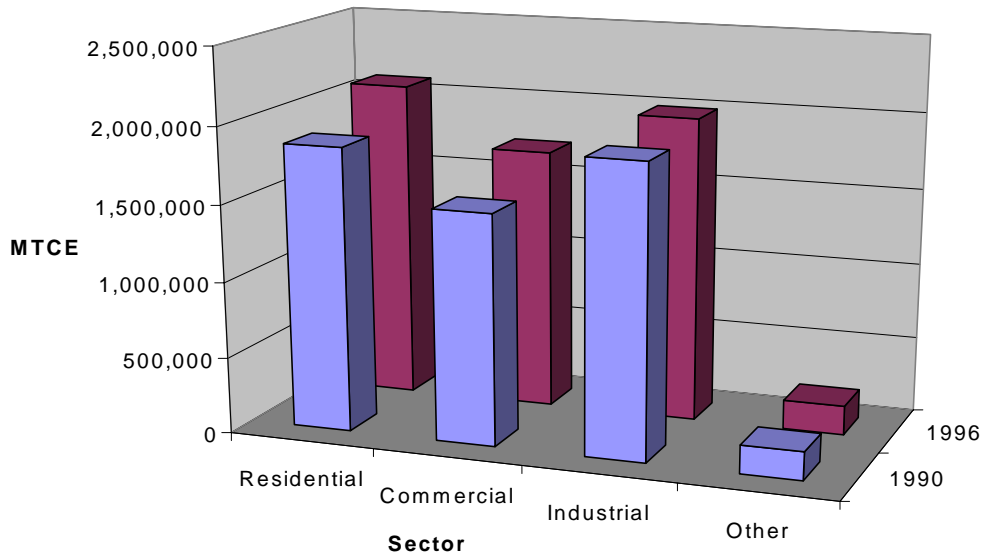
Figure 2 shows the contribution of GHG emissions by source expressed in **MTCE** for 1990 and 1996.



We charted the distribution of GHG emissions from electricity consumption by sector since emissions from electricity are such a large part of the GHG Inventory. The chart allows GHG reduction strategies to focus on the significant sectors.

Figure 3 illustrates the **GHG emissions from electricity consumption** in 1990 and 1996 by sector. GHG emissions from the residential and industrial sectors are roughly equal, followed closely by the commercial sector with other uses a minor contributor.

Fig. 3: 1990 & 1996 RI GHG Emissions from Electricity Consumption



Note: The emissions from electricity use are distributed among the residential, commercial, and industrial sectors and other uses according to EIA RI Electricity End Use 1949-1999 (other uses: public street and highway lighting, other sales to public authorities, sales to railroads and railways, and interdepartmental sales).

Figure 4 shows the **absolute growth** of GHG emission from 1990-1996. GHG emissions from electricity consumption showed the largest growth followed by residential, commercial, transportation and industrial in decreasing order with other sources decreasing.

Figure 5 shows the **percent growth** in GHG emissions from 1990-1996. Commercial GHG emissions are growing at the fastest rate followed by residential and industrial (roughly equal), electricity consumption and transportation in decreasing order with other sources showing negative growth.

Fig. 4: 1990-1996 Absolute Change in RI GHG Emissions

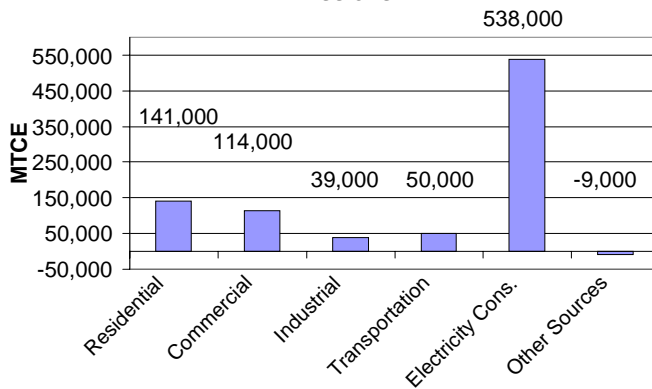
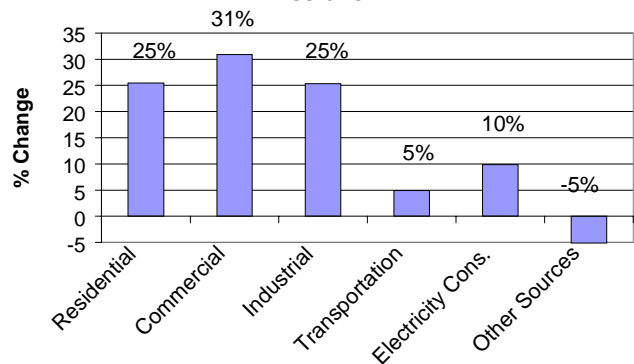


Fig. 5: 1990-1996 Percent Change in RI GHG Emissions



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Rhode Island Programs and Activities That Influence Greenhouse Gas Emissions

Introduction

The State of Rhode Island currently carries out a suite of activities that reduce greenhouse gas (GHG) emissions. These fall into several broad categories: (I) Buildings and Facilities Energy Conservation, (II) Renewable Energy, Energy Supply, and Waste Management (III) Transportation and Land Use, and (IV) Education and Public Relations. An underlying assumption of this report is that reduction of energy use is directly correlated to the reduction in GHG emissions. The policy development and administration of these activities operates at the federal, state and local level. These activities often have significant additional benefits beyond reducing GHG such as improved economic competitiveness and reduction of criteria air pollutants.

(I) Buildings and Facilities Energy Conservation

The majority of energy conservation programs are overseen by the RI State Energy Office and the Demand Side Management Collaborative administered by Narragansett Electric.

(II) Renewable Energy, Energy Supply & Waste Management

The RI Renewable Energy Collaborative and State Energy Office sponsor renewable energy projects in RI. Waste management activities in RI that reduce GHG emissions include recycling through municipal programs, state requirements for recycling commercial waste and landfill methane gas recovery.

(III) Transportation and Land Use

RI Statewide Planning ensures that the best transportation projects available are implemented through the Transportation Improvement Plan. RI Department of Environmental Management (DEM) administers programs that can help reduce GHG and criteria air pollution emissions. Land use initiatives cover a wide array of areas from smart growth, transportation, to local and statewide planning.

(IV) Education and Public Relations

Brown University and DEM have developed a GHG educational web site for K-12 students that provide examples of how to reduce GHG through everyday choices.

How does RI rank among other states in the US relative to energy and carbon efficiency?

Energy use in the U.S. has fallen 42% per gross domestic product between 1970 and 1999, with 75% of this drop in energy use due to energy efficiency improvements. These improvements in energy efficiency are highly variable among states. Table 1 shows the five best and worst states for per capita energy use, with other energy and carbon intensity rankings in subsequent columns. Nationally, the increase in energy and carbon efficiency ranking is most strongly correlated with average energy price increase, with the degree of urbanization and presence of energy-intensive industries showing a weaker correlation. Climate does not appear to affect the overall rankings. This indicates that the top ranking states have promoted more energy efficiency improvements than low-ranking states (ACEEE, *National and State Energy Use and Carbon Emissions Trends*, September 2000).

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Table 1: 1997 State ranking according to energy and carbon use (GSP: Gross State Product).

State Rank (1997 data)	Energy Use per Capita Rank	Energy Use per GSP Rank (1996 \$)	Carbon Emissions per Capita Rank	Carbon Emissions per GSP Rank (1996 \$)
Hawaii	1	4	6	7
New York	2	3	3	2
Rhode Island	3	8	7	11
California	4	6	4	7
Connecticut	5	2	10	3
North Dakota	47	48	48	49
Texas	48	43	47	43
Wyoming	49	49	50	50
Louisiana	50	51	49	51
Alaska	51	50	51	48

(Source: ACEEE, *National and State Energy Use and Carbon Emission Trends*, September 2000)

Figures 1-4 below show the values of the energy and carbon intensities for the above states.

Fig. 1: 1997 Energy Use per Capita (MWh)

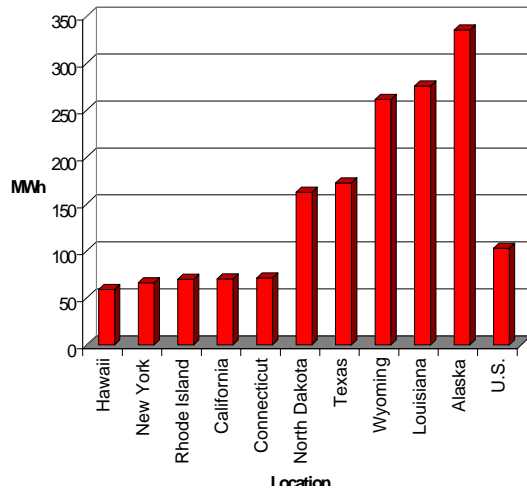


Fig. 2: 1997 Energy Use per GSP (kWh/\$)

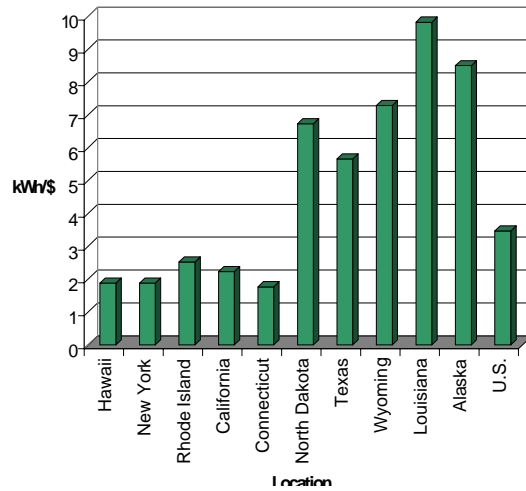


Fig. 3: 1997 Carbon Emissions per Capita (Tons)

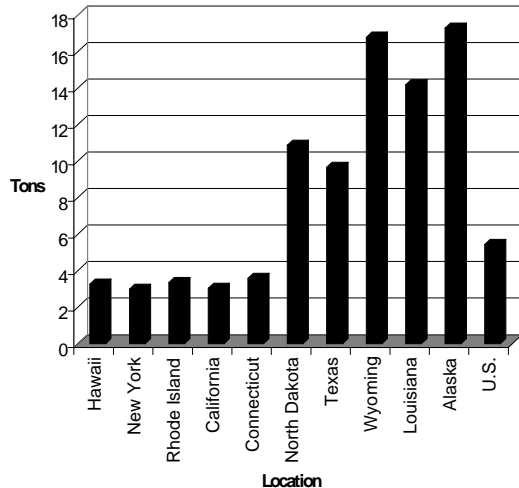
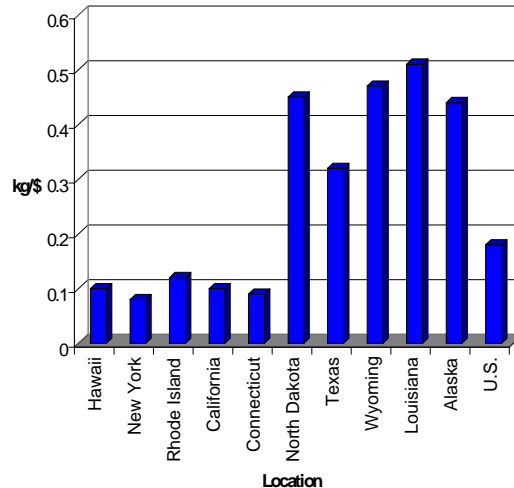


Fig. 4: 1997 Carbon Emissions per GSP (kg/\$)



I. ENERGY CONSERVATION

The Energy Policy Act of 1992

The U.S. Energy Policy Act of 1992 (EPACT) is a comprehensive energy bill that covers practically every aspect of energy use ranging from efficiency requirements for lighting manufacturers to provisions that allow the development of competitive electricity supply markets. The provisions in EPACT that affect regulated utilities are estimated to save 275 billion kWh, avoid construction of 104 coal plants (500 MW), reduce 20% of the projected electricity demand growth, and reduce carbon emissions by 34% during the period 1993-2010.

How Does EPACT Effect Regulated Utilities?

EPACT created additional authority for the Federal Energy Regulatory Commissions to create a competitive electric power market. This allows states to place greater reliance on competitive forces to bring about the greatest overall economic efficiencies that utilities can achieve. In addition, four new obligations under EPACT were created for state public utility regulators through amendments to the Public Utility Regulatory Policies Act of 1978. These new standards must be considered by state public utility commissions, but adoption is voluntary. The new standards required for consideration are conservation and energy efficiency by electric utilities and long-term wholesale power purchase:

- (1) Integrated resource planning
- (2) Investments in conservation and demand management
- (3) Energy efficiency investments in power generation and supply
- (4) Long-term power purchasing from a wholesale generators:
 - (a) Comparison of costs for wholesale purchase and self generation
 - (b) Jeopardy of power supply from debt load of wholesaler
 - (c) Standard guidelines for approval or disapproval for wholesale power purchase and
 - (d) Assurance of adequate fuel supply for pre-approval of purchased power.

Other Important Aspects of EPACT:

- Limits the manufacture of poor-performing lamps. This requirement acts as a uniform standard across all manufacturers that transforms the market toward more energy efficient technologies.
- Requires that every state meet or exceed minimum established energy codes for commercial buildings. States are required to revise these building codes as national standards change.
- Established increased efficiency requirements for electric motors, which consume over half of the electricity generated in the U.S. This has a large impact on reducing GHG since 40% of all fossil fuels are burned to generate electricity. This covers all motors sold in the U.S.
- EPACT Section 1605 established a national inventory and database for voluntary reporting of GHG reductions. Voluntary GHG reductions that may be registered include:
 - Carbon fixation by any means
 - Fuel switching
 - Forest management practices
 - Use of renewable energy
 - Vehicles with reduced GHG emissions
 - Appliance efficiency
 - Methane recovery
 - Cogeneration
 - CFC capture and replacement
 - Power plant heat rate improvement

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The Rhode Island State Energy Office (SEO) administers programs that serve to increase energy efficiency in two main divisions: Weatherization Assistance Program and Energy Projects. Table 2 summarizes energy savings in Rhode Island in 1999 and from 1977-1999. The information is sorted by 1999 energy saved, emphasizing the importance of recent activities.

Table 2: Energy Savings in 1999 and 1977-1999

Energy Savings Strategy	1999 Energy Saved (MWh)	1977-99 Energy Saved(MWh)
Cogeneration	11,214,960	152,008,546
Wood Space Heating	163,309	1,571,862
State Bldg. Energy Cons.	121,805	995,930
Thermal Efficiency Standards	89,802	24,786,592
Industrial Workshops	73,786	178,160
Solar Energy Clinics	41,314	439,522
Institutional Cons. Program	39,124	18,042,193
55 MPH Enforcement	35,189	706,910
Hydro Development	12,409	844,377
Right Turn on Red	12,078	238,658
Waste Oil Recycling	6,023	30,071
Hotline Info Center	4,887	1,244,912
Student Energy Instruction	4,860	709,147
Residential Conservation Service Audits	4,255	2,373,326
Commercial Workshops	2,729	944,239
Lighting Audits	2,632	66,108
AFV Utilities	2,026	2,023
AFV State Fleet	2,019	864,047
Residential Energy Conservation Measures	1,376	39,153
Wood Clinic	1,107	9,288
Industrial Audits	975	550,200
Rebuild America	659	1,748
Bio diesel	652	1,142
Passive Solar Design	627	5,045
AFV RIPTA	615	615
Appliance Management Program	430	498
Solar Space Heating	425	9,296
AFV Private	258	258
Model Energy Code Check	127	624
AFV Municipalities	87	85
Solar Domestic Hot Water	76	55,380
AFV School Buses	42	260,554
Commercial Energy Conservation Measures	0	91,529
Commercial Class Audits	0	118,484
Wind Development	0	1,441
Lighting Energy Standards	0	548,242
Training for Bldg. Maint.	0	61,488
Window Treatment Clinics	0	59
Total	11,840,662	207,801,750

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Weatherization Assistance Program

The Weatherization Assistance Program (WAP) helps low-income family homes become more energy efficient and is funded by a grant from the U.S. Department of Energy (DOE). WAP provides funds for energy audits and implementing recommendations for energy conservation. This includes installing the appropriate materials and inspecting the completed work to insure the work is properly done. The program serves approximately 850 clients statewide. Since 1977 WAP has:

- Audited over 26,000 homes
- Served over 71,571 clients
- Saved more than 7 trillion BTU's (equal to 52 million gallons of heating oil)

Energy Projects

This section serves as an umbrella program for all other SEO energy projects. It is responsible for residential, commercial, industrial, transportation, renewable energy, and building code projects. These projects are funded by the DOE, oil overcharges and special grant funds.

(a) Residential Renewable Energy Tax Credits

In 2000 a renewable energy tax credit bill was passed that gives both a sales tax rebate and income tax credit on these systems. Photo-voltaic, solar hot water, solar space heating and wind systems qualify for these credits. The entire sales tax of qualified systems is rebated through the SEO. The income tax credit is based on a percentage of the cost of the system up to a maximum cost of \$15,000, but the percentage decreases in succeeding years. In 2000, an income tax credit of 25% of the system cost is available and decreases by 5% a year until it is phased out after 2004.

(b) Appliance Management Program

The electric utility companies offer an Energy Wise Program (see below) that secures maximum conservation through the installation of electric efficiency measures for low-income customers. The SEO Appliance Management Program (AMP) is the lead agency in the implementation of this, which provides comprehensive electric energy audits, inefficient appliance replacements and customer education through the Energy Wise Program. The AMP is for customers served by the utilities low-income discount rate and/or receiving fuel assistance and who use at least 13 kWh of base load per day.

(c) Block Island Project

The SEO was awarded about \$400,000 in 2000 from a DOE grant to promote the use of renewable energy sources on Block Island. The grant provides 25% of the cost of a solar or wind system on the island, with approximately 30-40 projects targeted. One of the most abundant sources of renewable energy in Block Island is wind power. Successful wind projects have been completed in the past, starting with early technology for wind generation. However, some of the experiences with the early wind generation technology was not completely positive, which led to a Block Island municipal government moratorium on wind projects.

(d) Revolving Loan Fund

The SEO has over 1 million dollars in a restricted account to allow state and municipal buildings to borrow monies at a one time rate of 15 % for amounts under \$50,000 and 10% over \$50,000 over 5 years (2-3 % annual rates). This funding can be used for energy conservation, water

and sewer projects, and the incremental costs for alternative fueled vehicles. To date the fund has reduced overall municipal building energy demand by 3.6 megawatts and saved \$1.2 million in annual electric usage.

(e) Industrial Audits

SEO and the University of Rhode Island (URI) have formed a partnership to perform intense building audits on industrial facilities to raise awareness of energy efficient practices. This is a practical educational experience for URI engineering students that work with industrial facilities to do process and engineering studies and provide recommendations for improvements in energy efficiency.

(f) Building Code Grants

The SEO is funded by a DOE grant to work on commercial building code issues on a regional basis. The Northeast Energy Efficiency Partnership provides technical expertise to update and improve the commercial building codes beyond existing standards. The SEO also worked with Rhode Island state building code officials to design and implement an educational outreach program for model energy codes and intensified code monitoring and enforcement.

(g) Biomass Grant

This is an ongoing program to increase biomass energy development and use in the Northeast. The Rhode Island side of this grant program is aimed at improving state agency coordination and strengthening state capabilities with regard to biomass development. Specific activities that may be undertaken with this grant include information dissemination, state agency planning and coordination, technical assistance, research and development. The grant also targets demonstration projects such as landfill gas, ethanol studies, biodiesel in the marine area and wood use.

(h) Rebuild America

This \$100,000 DOE grant aims to improve energy efficiency and reduce energy costs in the municipal building stock through cooperative efforts. Funding is available for consultants or staff to develop municipal action plans to save energy in their buildings.

RI Demand Side Management (DSM) and Renewable Energy Collaboratives

In 1996, the Rhode Island General Assembly passed the Utility Restructuring Act (URA). This opened up the electricity market to competitive forces by requiring utilities to sell off generating facilities. The utilities retained electric distribution transmission lines and began purchasing power on the open market. Narragansett Electric has been funding DSM activities since 1987. The URA established a requirement for the continuance of DSM activities by utilities in RI. The environmental and economic impetus for continuance of the DSM program was to dampen the growth in demand of electricity to avoid building additional power generating facilities and the associated increase in pollution and electricity costs. The DSM requirement under the law was created, in part, because restructuring gave utilities less incentive for conservation since they are motivated by profit from electricity sales. To align the goals of the utilities with the goal of DSM, an incentive was established to encourage utilities to meet the targets of the DSM and Renewable Energy Collaboratives.

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The URA gave the RI Public Utility Commission (PUC) authority to determine the conservation factor from electricity sales that would be used to fund DSM activities as well as what portion of those funds would be used for renewable energy projects. The PUC set the conservation factor at 2.3 mills (0.0023 cents per kWh), which is scheduled to be reset by the PUC at the end of 2001. The PUC determined that 10% of all DSM funds must be used for renewable energy projects. The DSM budget is roughly \$20 million annually, with \$2 million allocated to renewable energy projects. The DSM program is primarily administered by Narragansett Electric, with some program overlap with the SEO for income eligible components. The DSM program is designed each year by the DSM Collaborative (Narragansett Electric, the Division of Public Utilities and Carriers, RI Attorney General, the Energy Council of RI, and the Conservation Law Foundation) and is approved by the PUC.

The Block Island Power Company (BIPC) has the highest electricity rates in the U.S. and was therefore exempted from the DSM program and the mill tax because there was no need to increase the already expensive electricity rates on Block Island. The BIPC does not pay into the Public Benefit Fund (PBF) from the mill tax and therefore does not participate in the DSM or Renewable Energy Collaborative as established by R.I.G.L. §39-2.1.2.

The DSM Program is divided into three main groups: residential, large commercial and industrial (C & I), and small C & I. The DSM Collaborative seeks to ensure that the DSM programs meet the following criteria: cost-effectiveness, service to a large number and broad mix of Rhode Island customers, maximize the long-term saving, capture potential lost opportunities, and promote market transformation (1999 PUC Stipulation of Parties).

DSM Residential Programs

(a) Energy Star Homes Program

The Energy Star Homes Program is part of a national energy efficiency campaign developed by the EPA and DOE. The program is part of a regional utility initiative that was created in 1998 to help builders and buyers design and construct homes that are 30% more efficient than required by the current Model Energy Code (MEC). It shows homebuilders and consumers how to achieve greater energy efficiency for heating, cooling, lighting and appliance operations. The purpose is to move the residential home building market toward greater energy efficiency. The program provides rebates for Energy Star appliances and lighting and is targeted to all elements of the new construction market.

All new home construction is eligible to participate in the program, with about 2,300 homes constructed each year in RI. The Energy Star New Homes Program completed 13 homes in 1998, about 70 in 1999, and expects to have completed 150 in 2000 in RI. The Energy Star Homes program offers new homeowners up to five Energy Star fixtures at no cost, rebates on additional fixtures from the Residential Lighting program (see below), and up to \$500 in rebates for Energy Star appliances.

(b) Energy Wise (In-Home Services)

The Energy Wise Program is available to multifamily and single family facilities where electric heat or other high electric use is present. The program provides education through free energy audits of customers' homes and information to customers on their actual electricity usage and provides rebates for measures that are cost effective.

The Energy Wise Program was initially offered in 1998 - serving 2,306 customers in 1998, 4,701 in 1999 and 4,300 expected to be served in 2000. Lighting fixtures, thermostats, heat pump upgrades, and insulation require customers to pay 15-25% of the cost depending on the measure.

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Refrigerator retrofits require a customer to pay 35-70% depending on the refrigerator. Measures that can be installed at no cost to the customer include air sealing, compact fluorescent light bulbs, low cost domestic hot water measures, waterbed insulation, appliance timers, etc.

(c) Residential Lighting

The Residential Lighting Program provides rebates to customers for Energy Star compact fluorescent lamps (CLFs) and CLF fixtures. These are provided through instant rebates for qualifying bulbs and fixtures at participating retail stores and by mail order catalog. All RI residential customers are eligible to participate in the program, with over 20% of RI residential customers estimated to have participated in the program since 1991. The Residential Lighting Program served 26,599 customers in 1998, 32,661 expected to be served in 1999 and 40,000 in 2000. The RI 2000 DSM budget provides rebates to customer for purchase of up to 63,000 fixtures and 93,000 light bulbs. This program is part of a regional joint utility collaborative that has significantly lowered marketing costs and increased retailer and manufacturer participation.

(d) Energy Star Appliances

The Energy Star Appliance Program seeks to make customers aware of the importance and benefits of purchasing Energy Star rated major appliance. The DOE and EPA use the Energy Star label to identify top performing, high quality equipment that are the most energy efficient, with the electric utilities in the northeast region offering a common residential Energy Star Appliance Program that is coordinated by the Northeast Energy Efficiency Partnership.

All U.S. residential customers are eligible to participate in the Energy Star Appliance Program, which was implemented in 1999. It is estimated that Energy Star Appliance purchases in Rhode Island have exceeded:

- 12,000 room air conditioners
- 27,000 refrigerators
- 19,000 dishwashers.

With the regional market penetration for Energy Star major appliances of 13%, 14%, and 12% for the above appliances respectively.

DSM Large C & I Programs

(a) Design 2000 Plus

The Design 2000 Plus program gives financial incentives and technical assistance to developers, customers and design professionals to encourage the adoption of energy efficient design features and equipment. The financial incentives cover 75-90% of the incremental cost difference between standard and premium efficiency equipment. Considering energy efficiency in the design process results in a significant increase in energy efficient construction. Design 2000 Plus is available to all non-residential customers with time-dependent projects, such as a new building, expansion of an existing building, renovation of an existing building, etc.

During 2000, the best practices of previous programs were selected so that it (1) is open to all customers; (2) is available for new construction and renovation; (3) provides technical assistance, commissioning, and other services; and (4) provides rebates for a variety of energy efficient measures. Measures that are eligible for rebates include lighting, motors, variable speed drives, heating, ventilation and air conditioning systems (HVAC), and custom measures such as refrigeration, industrial process, high intensity discharge lighting, and process cooling. The program is designed to transform the markets so that efficiency becomes an important factor in the

earliest stages of building design, construction and renovation. This is critical because if the early stages are missed, the efficiency improvement opportunities become more expensive to add later.

(b) **Complementary Services for Design 2000 Plus**

- **Technical Assistance:** Access to local technical consultants enables customers to thoroughly evaluate potential energy efficiency opportunities within their facilities and be assured that all qualifying measures are installed properly.
- **Comprehensive Design Approach:** This service provides outside expert technical support for the clients own design team, or reimburses the incremental cost of the client's design team for analyzing all cost-effective efficiency options.
- **Comprehensive Chiller:** The goal of the Comprehensive Chiller service is to optimize building operating systems at the time of CFC change-out or chiller replacement.
- **Commissioning:** This is an educational and technical service that provides independent, third party verification for complex building systems, such as HVAC projects that involve energy management systems or other controls, to ensure they are operating optimally both for occupant comfort and energy efficiency.
- **Financing:** This provides access to capital in order to finance the non-rebated project costs, thus removing potential capital barriers to energy efficient decisions and opportunities.
- **Ballast Recycling Service:** A ballast recycling service is offered to customers installing energy efficient lighting under Design 2000 Plus at no cost to ensure that all ballasts (some of which contain polychlorinated biphenyls or PCBs) are disposed of in an environmentally sound manner.

(c) **Energy Initiative**

The Energy Initiative is a retrofit program that focuses on energy savings opportunities for mechanical and electrical systems in commercial, industrial and government facilities. The Energy Initiative offers financial incentives and technical assistance to help customers analyze their existing operations, asses outdated and energy inefficient systems, and recommend opportunities for energy savings. Customers have the opportunity to replace inefficient equipment with energy efficient lighting, premium efficiency motors, HVAC, variable speed drives, etc. Rebates are designed to cover approximately 50% of the total installed costs, both labor and equipment, or to buy the cost down to the equivalent of a two-year payback for the customer, whichever is less.

Any non-residential customer is eligible to participate in the Energy Initiative, with customers under 100 kW eligible to participate in the Small C & I program (see below) for lighting, refrigeration measures, and other miscellaneous measures. To date, 938 large C & I entities participated in this retrofit program, or 48% of the eligible population (the participation rate may be overstated due to a single customer participating more than once).

Small C & I Programs

The Small C & I program provides direct retrofit installation of energy efficient lighting and other measures. Customers with an average monthly demand of less than 100 kW or annual energy use of less than 300,000 kWh are eligible for this program. The Small C & I program pays for 65% of project costs and customers may finance the balance for up to 24 months interest-free

(with the exception of 70% for refrigerators). Some of the available technologies offered through the program include energy efficient fluorescent ballasts, lamps, and fixtures, etc.

II. ENERGY SUPPLY, RENEWABLE ENERGY & WASTE MANAGEMENT

RI Energy Supply: Electricity Generation

Since the early 1990s, RI has brought more in-state electricity generating facilities online, gradually reducing the amount of imported electricity until RI became 100% self sufficient in the late 1990s. These new generating facilities are natural gas powered, which is the most carbon efficient fuel of the three fossil fuels used for electricity generation: coal, oil and natural gas. This means that RI cannot switch to a fossil fuel type that emits less GHG. In order to reduce GHG emissions from electricity generation either (1) new sources of renewable energy, hydroelectric or nuclear would have to be established or (2) the efficiency of the current gas fired power plants would have to be improved.

RI Renewable Energy Collaborative Projects

(a) Residential Photo Voltaic (PV) Projects

Small PV systems are installed in Rhode Island and metering data is collected to evaluate effectiveness. Residential, educational and non-profit audiences are targeting for these projects. Funding is available at \$1.50/Watt generated up to \$250,000. Approximately 10 PV systems have been installed at residences and educational institutions in RI.

(b) Commercial PV Projects

Two contractors have the goal to install up to 300 kW of commercial and industrial PV systems in RI. Commercial, industrial and institutional facilities qualify for these projects. A 43 kW system was installed in 1999, with another 25 kW system to be installed in Oct. 2000.

(c) Land Fill Gas Project

The Renewable Energy Collaborative intends to replace the 480 kW landfill gas-to-electricity unit with a larger, more efficient 800 kW unit in Cranston, RI. The Collaborative also seeks to expand the landfill gas-to-electricity unit at Central Landfill in Johnston. However, the Cranston project installation has been delayed due to permitting issues. \$300,000 has been funded for the Cranston project with Central Landfill project funding to be determined.

(d) Green Campus Project

The Green Campus Project was conducted at URI, which studied energy conservation and renewable energy opportunities to maximize the campuses green potential. The project has been completed with \$50,000 in Renewable Energy Collaborative funding.

(e) Fuel Cell Projects

A 200 kW ONSI PC25 fuel cell was installed at the South County Hospital in Wakefield, RI in 1999. Solicitation is still open for two other 200kW fuel cells. In addition, a contract for small-scale fuel cells (< 10 kW) has been signed with Avista Labs who is scheduled to deliver a few units in early 2001. \$325,000 was funded for the South County Hospital fuel cell, \$840,000 for the next two large fuel cells and \$60,000 for small scale fuel cells.

(f) Photo Voltaic Outdoor Lighting

The Renewable Energy Collaborative continues to install PV outdoor lights at several different locations along with data collection for performance evaluation. If the results are successful, a workshop will be given to educate major market players and customers about PV outdoor lighting opportunities. \$50,000 has been funded for PV demonstration projects, with \$20,000 for workshops. Four PV outdoor lights have been installed at a cemetery in East Providence, a University in Smithfield, a vocational school in Lincoln and a community college in Lincoln.

(g) Wind Project

Funding was provided for feasibility to study the use of wind power to generate electricity in Rhode Island. The work included identifying potential sites and construction of up to three wind turbines for a maximum generating capacity of 2.1 MW. \$100,000 was provided for the feasibility studies with \$400,000 available for actual installation. However, no viable sites have been found due to lower than expected wind speeds and land siting issues. The Renewable Energy collaborative is evaluating the installation of a small-scale (10kW) wind turbine demonstration project.

(h) Notice of Open Solicitation for Renewable Energy Projects

The Renewable Energy Collaborative has an open solicitation for renewable electric generation projects not covered by other funding categories. \$425,000 was available for such proposals in 2000.

Waste Management

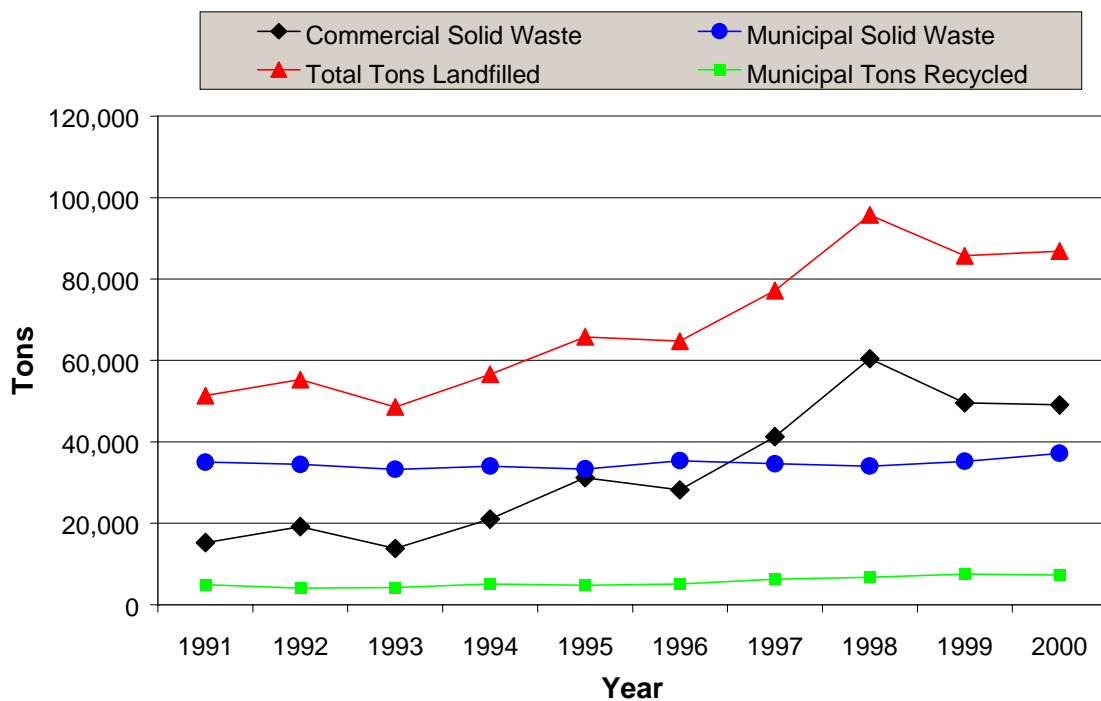
Waste management in Rhode Island is split into two main groups, municipal and commercial. The Rhode Island General Assembly subsidizes tipping fees for municipalities at \$32/ton up to a yearly tonnage cap. After the annual cap is reached, the standard \$58/ton tipping fee applies. However, these annual caps are set at historical waste disposal levels for each municipality, so it is rare that the caps are exceeded. Commercial waste in RI is handled mainly by three large waste haulers. The standard non-contract tipping fee is \$58/ton. However, these commercial waste haulers usually sign contracts for a minimum tonnage of waste disposal at a reduced rate.

The Rhode Island Resource Recovery Corporation (RIRRC) works with municipalities to administer recycling programs, which reduces the overall waste that is landfilled. There are commercial recycling requirements, but RIRRC does not have data on this recycling rate since the commercial haulers process it. Figure 5 below shows the RIRRC waste profile by total tons landfilled, municipal solid waste, municipal tons recycled and commercial solid waste. The spike in commercial solid waste in 1998, and therefore total solid waste landfilled, is likely due to out of

state solid waste being disposed in RI. Since then, out of state solid waste disposed of in RI has decreased. The data show a 20% municipal recycling rate in 2000.

Methane gas from landfills is a potent GHG - 30 times more potent than CO₂. During the last eight years, there have been only four landfills in operation: Central, Tiverton, Bristol, and Charlestown. Central landfill in Johnston is the recipient of most of RI solid waste. The Tiverton, Bristol and Charlestown landfill are small and only accept solid waste from those municipalities. Currently Central landfill has a methane recovery system that captures the majority of methane released with about 50% used to generate electricity and the rest flared. The conversion methane to CO₂ and water from combustion greatly reduces the GHG impact from methane. The Cranston landfill, which is no longer in operation, has been funded for a new fuel cell system that would generate electricity from methane, however, the project is awaiting permit approval to move forward.

**Fig. 5: RI Resource Recovery Corporation
Waste Management Profile**



III. TRANSPORTATION AND LAND USE

Rhode Island Transportation Improvement Program (TIP)

The TIP is a list of transportation projects that the state of Rhode Island intends to implement using federal highway and transit funds. In RI the TIP is an extensive public outreach process to all communities by the agencies involved in transportation planning and project implementation. The TIP is a crucial aspect of transportation projects because of RI's heavy reliance on federal funding for transportation projects (80% of all transportation projects). RI's transportation program earmarks over 28% of its capital funding for alternate modes of transportation to automobiles - primarily rail and bus. Federal funding for expansion of the RI transportation system for 2001 and 2002 is 55% for rail, 32% for highways, and 13% for bike and

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pedestrian uses. There are three programs under TIP that reduce GHG emissions by promoting alternate forms of transportation: Congestion Mitigation and Air Quality, Bicycle and Pedestrian Program, and the Transit Program.

TIP Congestion Mitigation and Air Quality Improvement Program (CMAQ)

CMAQ is an innovative program established by the Intermodal Surface Transportation Efficiency Act of 1991 and was continued under the Transportation Equity Act 21 (TEA 21) passed in 1998. Rhode Island is classified under the Clean Air Act as being in non-attainment of national air quality standards. This status qualifies RI for federal CMAQ funds to be used for transportation projects that reduce air pollution. The majority of these projects also reduce GHG emissions through reduction of fossil fuel use in addition to the reduction of criteria air pollutants. The pollution reductions from CMAQ projects are equivalent to approximately 7,500 Rhode Islanders eliminating a 20 mile automobile trip every day. CMAQ projects and respective funding are shown in table 3 below, with brief descriptions of each project provided in table 4.

Table 3: Rhode Island CMAQ funding by project in millions of dollars

Project	CMAQ funding in millions of dollars						
	Sponsor	2001	2002	2003	2004	2005	2006
1) Inspection & Maintenance Prog.	Statewide	0.1	0.45	0	0	0	0
2) Bike Guide	Various	0.03	0	0.03	0.01	0.06	0.01
3) `Bike to Work/College	Providence	0.12	0.1	0.06	0.06	0.06	0.05
4) Bike/Pedestrian Connector	Barrington	0.02	0	0.14	0.04	0.04	0.04
5) Bus Replacement Program	RIPTA	0	0	0.6	0.7	0	0
6) Coordinated Signalization	Newport	0	0.07	0	0.01	0.01	0.01
7) DOT Traffic Mgmt. Center	Statewide	4	4	4	1	1	0
8) Arterial Signal System	Various	0.64	0.82	0.6	1.46	1.46	1.46
9) Heavy Duty Vehicle Inspection	Statewide	0	0.06	0.06	0.03	0.13	0.03
10) Transit Hubs/Paratransit	RIPTA	0.2	0.75	0.2	0.2	0.5	0.15
11) Middletown AF Renovations	RIPTA	0.6	0.7	0	0	0	0
12) Ozone Violation Day Program	Statewide	0	0.11	0	0.16	0.01	0.16
13) Pilot Ferry Service	RIPTA	0.25	0.75	0.75	1	1	1
14) Posted Intermodal Info. Program	RIPTA	0.1	0.1	0.09	0.04	0.08	0.04
15) Service Initiatives	RIPTA	1.7	0.6	0.59	0.41	0.55	0.41
16) State Bike/Pedestrian Prog.	Statewide	1.79	2.09	2.76	3.72	3.72	3.72
17) State CNG Infrastructure	Statewide	1.25	0.25	1	1	1	0
18) Express Travel	RIPTA	0.38	0.46	0.2	0.25	0.2	0.31
CMAQ Total:		11.18	11.31	11.08	10.09	9.82	7.39

CMAQ projects were solicited through a public outreach process in 2000, with a return of forty-four proposals totaling \$109 million in requested funding. Eighteen projects were selected for the 2000 round of the CMAQ program. The funding for these projects totaled \$11.18 million in 2001 and \$11.31 million in 2002. In May 2000 the Transportation Advisory Committee voted to include the eighteen projects recommended by the CMAQ Subcommittee in the 2001-2003 TIP.

TIP Bicycle / Pedestrian Program

The Rhode Island Bicycle/Pedestrian Program includes the planning, design and construction of bicycle paths and walking trails, on-road bicycle lanes, on-road bicycle routes

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Table 4: RI CMAQ Project Description

Project	Description
1) Inspection & Maintenance	The Rhode Island DEM plans to provide a maximum subsidy to automotive small businesses for training their Inspection and Maintenance repair technicians.
2) Bike Guide	The Rhode Island Department of Transportation will update and reprint the Statewide Bicycle Guide: <i>Guide to Bicycling in the Ocean State</i> .
3) Bike to Work/College	The Providence Foundation will implement a bike to work and college program that includes bike lanes, employer education, central bike station, etc.
4) Bike/Pedest. Connector	The town of Barrington will construct a 400-foot bikeway connecting County Road and the East Bay Bike Path as well as a new park-and-ride facility for RIPTA passengers.
5) Bus Replacement Program	RIPTA plans to replace older RIPTA diesel transit buses with new clean diesel transit buses. These vehicle purchases would include standard 40-foot transit buses and (5) 30-foot CNG-fueled low-floor buses.
6) Coordinated Signalization	The City of Newport will implement a closed loop coordinated signal plan for downtown Newport. The system would reduce vehicle delay and idle emissions.
7) DOT Traffic Mgmt. Center	RI DOT will expand the services of a statewide ITS system and Transportation management Center. The System will improve safety and reduce congestion delays and related air pollutant emissions on Rhode Island's interstates and major arterials.
8) Arterial Signal System	RI DOT will coordinate signals at 6 separate locations: Newport, Providence, Warwick, Middletown (2), and Coventry to reduce idling emissions.
9) Heavy Duty Vehicle Inspection	RI DEM will use CMAQ funds to implement Phase 1 of an Inspection and Maintenance program for heavy-duty gasoline and diesel fueled vehicles. The program will control smoke emissions from trucks and buses. It includes on-road identification of non-compliant heavy-duty vehicles and periodic inspections through inspection facilities.
10) Transit Hubs/ Paratransit	RIPTA will construct bus operation accommodations and passenger amenities at transit hubs and paratransit and demand response integration sites throughout the state. This will make public transit more accessible and should increase ridership
11) Middletown AF Renovations	RIPTA will renovate its Middletown facility to accommodate the storage and maintenance of an alternative fuel vehicle fleet. This renovation would allow the operation of all local service on Aquidneck Island with alternative fuels in the future.
12) Ozone Alert Program	RIPTA will provide the public with no-cost transit service on the days when DEM declares an "Ozone Alert" and would also fund a public awareness campaign for the service.
13) Pilot Ferry Service	RIPTA will initiate commuter ferry service between Providence and Portsmouth/Newport. CMAQ funds will be used for the first 3 years of operation to support operation, improvements to facilities, and marketing for the new service.
14) Posted Intermodal Info. Program	CMAQ will fund the production of information material and a staff position at RIPTA dedicated to designing and distributing transportation information (rail, bus, ferry, etc.) at key transportation sites throughout the state.
15) Service Initiatives	CMAQ funds would be used for two services. The first would subsidize the third year of operation for the downtown Providence LINK service, which operates CNG-powered trolley-replica vehicles that were purchased with previous CMAQ grants. The second would allow the introduction of demand-responsive transit service to Pawtucket-Central Falls, Westerly-Wakefield, Bristol, and Warren.
16) State Bike/Pedestrian Prog.	The RI DOT will design and construct 7 bicycle projects that will promote bicycle use as another form of transportation and reduce overall motor vehicle use in RI.
17) State CNG Infrastructure	RIPTA and the SEO, in partnership with the Ocean State Clean Cities Coalition will provide six CNG refueling stations and support services statewide to meet growing demand for refueling facilities as Federal, state, and municipal fleet operators increasingly purchase alternatively fueled vehicles.
18) Express Travel	RIPTA will use CMAQ funds to continue providing the Express Travel Rideshare Program, which educates Rhode Islanders about commuting options and coordinates carpooling through its RidePro carpool database.

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(signing and striping), and bicycling/pedestrian promotional programs and materials production. The Bicycle/Pedestrian Program receives federal funding and state matching funds. Four major bike paths that will form the backbone of the state greenway system are the focus of this program. These routes are the Blackstone River Bikeway, Woonasquatucket Greenway/Northwest Bike Trail, South County Bike Path, and Washington Secondary Bike Path. The total funding for 2001 and 2002s is nearly \$22 million for design and construction of bicycle/pedestrian projects.

TIP Transit Program

Buses

RIPTA currently operates a fleet of 235 buses with an expansion to 250 buses by 2006. Funds will have to be expended to purchase new buses to replace older buses in the fleet. The TIP will fund the purchase of 126 new buses at a cost of \$31.41 million by 2006. A total of \$12.53 million is allocated for 2001 and 2002 to purchase 34 forty-foot buses, 12 twenty-six foot buses and 5 CNG trolley replicas. Forty-eight existing transit buses (1992 fleet) will be funded for remanufacture.

DEM: Reduction of Transportation Criteria Air Pollutants

DEM has two requirements that are part of the State Implementation Plan, designed to bring RI into compliance with EPA air pollution standards. These requirements are reformulated gasoline and vehicle inspection and maintenance, which have the potential to reduce greenhouse gas emissions from transportation sources.

Reformulated Gasoline

In RI, gasoline is required to have MTBE added (methyl-tertiary-butyl-ether). This allows more complete combustion and reduces criteria air pollutants, which contribute to ozone formation. However, this also leads to a decrease in fuel efficiency by 1-2%. This means that even though criteria pollution is reduced, GHG emissions are increased. An alternative to this strategy would be to use an additive produced sustainably from atmospheric carbon dioxide, such as ethanol. Using ethanol would provide comparable reductions in criteria pollutants while reducing GHG since it is a biofuel (derived from corn). In addition, a switch from MTBE to ethanol would be harmonized with the goal of protecting water supplies since MTBE has a long lifetime, has been found in drinking water in areas of heavy use (such as Texas), and is a suspected carcinogen.

Vehicle Inspection and Maintenance Program

Beginning in 2000, RI DEM instituted the vehicle Inspection and Maintenance program. This new program went beyond the traditional safety program employed in the past by testing each vehicle's tail-pipe emissions under driving conditions by using a device similar to a tread-mill. Vehicles that do not pass the emissions inspection are required to have the causes repaired. This optimizes combustion allowing fuels to burn more completely and efficiently, increasing fuel efficiency an average of 6-7%. This increase in fuel efficiency reduces GHG and criteria air pollutant emissions.

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Land Use

Land use has significant impacts on community organization and development patterns in RI. The term 'Sprawl' has been used to describe unplanned development that is not organized for efficient transportation and utility distribution patterns. Such inefficient development patterns contribute to GHG emissions because of increased energy use for transportation and utility distribution. Recently, Smart Growth has been an approach advocated by Governor Almond in addressing the adverse effects of Sprawl. At the most basic level, Smart Growth aims to prevent the adverse environmental, social, and economic impacts of unplanned development in communities. In February 2000, Governor Almond issued Executive Order 00-2 to create the RI Growth Planning Council.

Table 5: RI Growth Planning Council priorities for Smart Growth

Agency/Program	Area of Influence			
	Policy	Regulation	Finance	Facilitation
(a) Dept. of Administration (DOA)				
1. State Properties (siting)	X		X	
2. Community Development Block Grant			X	
3. Local comprehensive Plans	X			X
4. Comprehensive Econ. Development Strat.	X			X
5. State Guide Plan	X			
(b) Economic Development Corp. (EDC)				
1. Enterprise Zone program	X		X	
2. Mill Buildings Revitalization			X	
3. Industrial Facilities Corp./Industrial Recreational Building Authority			X	
4. Certificates of Critical Economic Concern		X		X
(c) EDC & DEM				
1. Brownfields Revolving Loan Fund			X	
(d) Primary & Secondary Education				
1. School Construction Aid	X	X	X	
(e) DEM				
1. Individual Sewer Disposal System Prog.		X		
2. Open Space, Recreation Development, & Recreational Greenway Grants			X	
3. Clean Water Finance			X	
4. Agricultural Lands Preservation Funds			X	
(f) Hist. Pres. & Heritage Commission				
1. Pres. of historic buildings, etc.		X	X	
(g) Housing Mortgage & Finance Corp.				
1. Rental Production Program			X	
2. Single-family mortgage programs			X	
(h) Dept. of Transportation (DOT)				
1. Access Management Program		X		
(i) DOT & DOA				
1. Transportation Improvement Program	X			X
(j) Water Resources Board				
1. Public Water Supply Facilities		X	X	

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The Growth Planning Council has examined those programs that are perceived to influence growth and appear to offer an opportunity to readily refocus that influence. Table 5 provides a list of 21 programs was developed and provides the basis for the program, policy and expenditure inventory, with a final report forthcoming that includes a summary analysis and recommendations. A brief description of programs, policies, expenditures that have the most influence on GHG emissions are provided below.

DOA

1. State Properties

The siting of state office facilities, service centers, and educational facilities is perceived to be a major contributor to urban revitalization. State laws governing the siting process for such state facilities have established a State Properties Committee and direct the Committee to give preference to sites in urban areas. The intention is for the facilities to make a significant impact on the economic vitality of the community's central business district. Due consideration is given to urban impact factors such as including enterprise zones and consistency with local comprehensive plans.

2. Small Cities Community Development Block Grant (CDBG)

This is a federally funded program through which the state provides grants to 33 non-entitlement communities, with fiscal year 2000 funding totaling \$5,644,000. The goal is to develop viable urban communities by providing decent housing, suitable living environments and expanded economic opportunities, especially for those with low and moderate incomes.

3. Local Comprehensive Plans

The Rhode Island comprehensive Planning and Land Use Regulation Act was enacted in 1988 and requires all municipalities to prepare and adopt a comprehensive plan according to specific guidelines and public input. This provides a framework for the update of land management law at both the State and local level. All thirty-nine Rhode Island municipalities have adopted comprehensive plans and twenty-four of these have been approved by the State.

The RI planning statute gives incentives for communities to have their plans approved by the state by giving protection to communities from State action deemed to be inconsistent with a State approved local plan, the only apparent incentive for local communities to have their plan approved by the state. Disincentives for municipalities to have their local plan approved by the state arise from local zoning and subdivision ordinances that must be brought into compliance with State requirements. Furthermore, although the State-approved plans reflect community interests that are consistent with those of the State, communities with approved plans are seldom treated any differently than those who have failed to gain approval.

4. Comprehensive Economic Development Strategy

Rhode Island economic development projects must be included in the State Comprehensive Economic Development Strategy (CEDS) priority list for grant consideration by the U.S. Economic Development Corporation. The RI Statewide Planning Program prepares the CEDS for the State. The scoring criteria for the CEDS priority list favors urban and sustainable development projects, economically distressed areas, and those that reuse or rehabilitate existing facilities. More than forty percent of a project's score is attributed to its location an environmental impact, with

enterprise zones and communities with State approved local comprehensive plans given a slight preference.

Economic Development Corporation (EDC)

1. Enterprise Zone Program

There are eleven enterprise zones, generally high-density urban areas of disinvestment, designated in Rhode Island based on economic distress criteria. The program provides generous tax credits to businesses locating or expanding its workforce in the designated areas.

2. Mill Revitalization Program

The Mill Revitalization Program provides specific tax incentives for the rehabilitation and reuse of older mill buildings that are proposed by local communities. Businesses in such buildings are eligible for tax credits comparable to those provided in enterprise zones. Such properties must be at least fifty years old, have at least 2 floors and be used primarily for manufacturing, wholesale trade or other commercial purpose.

EDC and DEM

1. Brownfields Revolving Loan Fund

In an effort to bring contaminated sites into economic reuse, EDC and DEM offer low interest loans for cleanup of contaminated sites through a \$1 million EPA grant. It is likely that this \$1 million in capitalization for the revolving loans is insufficient to meet current needs.

Primary and Secondary Education Construction

1. School Construction Aid

Schools have traditionally served as the activity center of neighborhoods under traditional city planning. Currently, the location of elementary and secondary schools are influenced by additional factors such as state guidelines governing the eligibility of local districts to receive State aid for approved school construction. The fiscal year 2001 State budget provides \$30.8 million for school construction. School siting to minimize the need for auto travel, school bus transportation and to provide close proximity to other municipal facilities such as libraries can help promote grow smart and sustainable development objectives and thus reduce GHG emissions. Current RI Department of Education guidelines for new school facilities, additions, and renovations contain a number of elements that reinforce smart growth objectives. Other guidelines, however, make it very difficult to site or renovate schools in urban or village centers. These include:

- requiring the cost per square foot of renovation to be less than that generally accepted for new construction
- recommending that the school site be of sufficient size "to accommodate the building and planned future additions as well as outdoor education facilities, parking, bus turnarounds, delivery areas . . ."
- requiring a *minimum* site acreage of 10 acres plus one additional acre for each 100 elementary students, 20 acres plus one for each 100 junior high students, and 30 acres plus one for each 100 high school students.

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DEM

1. Individual Sewer Disposal System (ISDS)

Infrastructure in the form of water supply and wastewater treatment is generally not available in rural areas. This is an important consideration for promotion of growth in existing town and village centers. The siting of new on-site wastewater treatment systems, such as ISDS, can provide a means to minimize land area compatible with compact development. The RI Department of Health strongly encourages the extension of existing public drinking water systems rather than the development of private wells or new small public water systems to prevent use of private wells or new small public water systems that have been contaminated by on site wastewater treatment.

2. Open Space, Recreation Development and Recreational Greenway Grants

DEM manages numerous grant programs such as open space, greenways and agricultural land preservation programs. The scoring criteria for these grant programs heavily weighs the individual program with minimum consideration given to targeted investment policies such as enterprise zones or how a project conforms to local comprehensive plans. The competitive nature of these programs and the limited resources available for investment appear to warrant additional incentives to be provided for those projects that can demonstrate a direct correlation with the implementation of a State approved local comprehensive plan.

RI Housing Mortgage and Finance Corporation (RIHMFC)

1. Rental Production Program

RIHMFC is funded \$1.25 million annually in low income housing tax credits from the federal government. These tax credits are then allocated to competing developers for the creation of quality rental housing. The tax credits enable the developers to raise equity for their developments. A significant portion of these tax credits is targeted to urban areas in RI, including Providence, Woonsocket and Central Falls. This helps revitalize neighborhoods by funding the rehabilitation of abandoned buildings and vacant lots. This program can contribute to sprawl when, on occasion, new construction in suburban areas is funded, although such development is in areas where there is a need for low to moderate income rental housing.

Department of Transportation (DOT)

1. Access Management Program

An important transportation and land use issue focuses on preservation of transportation corridors by better managing the adjacent land use access to these corridors. This can be achieved by controlling access through either acquisition or land management.

DOT and DOA

1. Transportation Improvement Program (TIP)

See previous description of TIP.

IV. EDUCATION

National Energy Education Development Project

The National Energy Education Development (NEED) Project is a nonprofit education association whose mission is to promote an energy conscious society by creating networks of students, educators, business, government and community leaders to design and deliver objective, multi-sided energy education programs. The Rhode Island NEED programs began in 1987. SEO is the major sponsor of this program, contributing \$20,000 annually. There are approximately 300 schools in Rhode Island with about 102 participating in the NEED program.

NEED has developed a new energy management program for schools called "Saving Energy At School". The program teaches students about energy consumption, efficiency, and conservation through a series of hands-on-activities that use the school as a laboratory. The curriculum requires kits of equipment to assist students in measuring and experimenting with energy usage. Narragansett Electric is expected to fund 100 kits in 2000.

Rhode Island Climate Change Educational Resource

Brown University, in partnership with RI DEM, developed an interactive educational web site for middle and high school students. This interactive site is linked to the RI Greenhouse Gas Inventory web site and allows students to explore the Inventory as they answer questions about how to reduce GHG emissions through their everyday choices. The site is located at:
www.brown.edu/Research/EnvStudies_Theses/GHG/education/ .

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OVERVIEW OF GREENHOUSE GAS EMISSIONS ACTION PLANS FROM OTHER STATES.

Why look at other states' plans?

As Rhode Island studies avenues for a greenhouse gas emissions action plan it is important to consider the content and structure of other states' action plans. Thirteen states have completed greenhouse gas action plans. All thirteen plans were reviewed and relevant strategies and policies summarized in a matrix according to sectors.

This list of what other states are doing or proposing to do to reduce greenhouse gas emissions in their states gives Rhode Island an idea of the *range and type of strategies* that are possible to implement here at home. Some of these strategies are very *innovative* or cutting-edge and can therefore give us some idea of how to tackle greenhouse gas emissions reductions in perhaps a new way. It is also important to consider that *Rhode Island is unique* and will therefore have its own outlook and approach on the issue of greenhouse gas reductions.

A closer look at New Jersey's Action Plan

Certain states share similar characteristics and their plans may be more useful to look at because they bear more relevance to the issues we face here. For example, New Jersey is a relatively small Northeast state with the highest population density in the country much like Rhode Island, which is the smallest state and ranks second in population density in the nation. In New Jersey as in Rhode Island, the aggregation of fossil fuel combustion from residential, commercial and industrial (stationary) sources make up the bulk of greenhouse gas emissions in the state.

What is New Jersey doing to effectively address these emissions?

In the area of energy efficiency and conservation there's an opportunity to reduce greenhouse gas emissions in the residential, industrial and commercial sectors. To address emissions reductions in the transportation sector, New Jersey started a pilot project called "travel-blending". As part of this project, 200 households along a major interstate highway were studied for their household travel behavior and this information was used to develop a traveling profile with suggestions on how to reduce their car use. New Jersey has also focused heavily on getting the major industrial businesses to agree to energy efficient strategies in their Action Plan. Their approval of the plan was critical because industries play such a major role in the economy and environment of NJ. But in order to have industries sign on to the plan NJ limited their recommended strategies to only those that were voluntary and strictly cost effective. Another important note is how New Jersey structured their Action Plan. They lay out strategies according to "Recommended Strategies" categories that include energy conservation and innovative technologies not sector-based groupings. Although we are proposing to organize the RI GHG Action Plan according to strategy type not sectors, the strategy types selected for RI are broader.

A closer look at Delaware's Greenhouse Gas Action Plan.

Another comparison can be drawn between Rhode Island and Delaware because again they are both Eastern states, relatively small in size with the bulk of Delaware's greenhouse gas emissions resulting from the combustion of fossil fuels in the residential, commercial and industrial sectors much like Rhode Island. The Delaware Action Plan is organized according to sectors such as industrial, residential and waste etc. The Plan outlines three levels of implementation using an Econometric Model to predict reductions of greenhouse gases. The Plan's goal is to reduce emissions by up to 7% below the 1990 levels. Each

How is the Strategy Matrix organized?

For the purpose of our stakeholder subgroups, the Strategy Matrix (Appendix A) is organized first by strategy type and secondly (sub-head) by sector. This allows each sector subgroup to look at strategies that are relevant to their sector while still considering all the other possible strategy types. A glossary of terms for strategies is provided in Appendix B. The recommended strategy categories include:

- | | |
|--------------------------------|--|
| 1. Energy Conservation; | (a) Cross-cutting measures [residential, industrial, commercial] |
| | (b) Industrial [energy generation] |
| 2. Waste Management | (a) Recycling |
| | (b) Pollution Prevention |
| 3. Transportation | |
| 4. Land Use | |
| 5. Education | |

The matrix is intended to be a catalyst for a discussion of strategies and options. It also serves as a common starting point from which stakeholders can begin an informed discussion of real strategies to be considered here in Rhode Island. The strategies are organized by sectors to easily ascertain their relevance here in Rhode Island – although some of the strategies such as Education are crosscutting. A column for Rhode Island is also included in the Strategy matrix. The “Y” in the RI column describes a strategy that is already implemented to some extent even without a GHG Action Plan in place. The “Y” for other states indicates either that the state has already implemented or is proposing to implement a strategy presented in their GHG Action Plan.

The second piece of the matrix puzzle that is not shown in the matrix is the implementation level. The matrix outlines the major strategies for each state according to sector but it would also be useful to know the degree to which strategies are being implemented in each state. Which strategies have been more difficult or easier to implement and why. This “level of implementation” information gives a richer, more complete picture of what can be done to

reduce greenhouse gas emissions here in Rhode Island. Unfortunately, either because GHG Action Plans in these states are too recent or the information has not yet been gathered sufficiently, we do not have a good sense of the level of implementation that's actually been achieved for each plan's strategies.

Appendix A: GHG Strategy Matrix

STRATEGIES FOR REDUCING GHG EMISSIONS

The Rhode Island Column is on a different Yes/No scale from the rest of the Matrix. In the case of Rhode Island, the Yes refers to strategies that are already in place to some degree. In the case of the other 13 states, the Yes refers to proposed strategies from their GHG Action Plan that may or may not be implemented.

* Very broad based strategy that may encompass other more targeted strategies under the same heading.

STATE	RI	CA 97	DE 99	HI 98	IL 99	IO 96	KY 98	NJ 99	NC 00	OR 95	TN 99	VT 98	WA 96	WI 97
STRATEGY TYPE														
1. Energy Conservation														
(a) Cross-Cutting measures; Commercial, Residential, Industrial														
Increase or promote participation in Federal programs for energy conservation and renewable energy (i.e. Energy Star Program, Green Lights, Energy Rating Sys, etc.)	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y			Y
Promote more energy efficient heating, ventilation, lighting, & HVAC systems	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Update and Enforce building codes that promote energy efficiency	Y	Y	Y		Y	Y	Y	Y	Y		Y	Y		Y
More stringent energy efficient standards for new & existing bldgs. (Weatherization)	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y
Improve efficiency by targeting retrofits and lost opportunities	Y	Y	Y					Y	Y		Y	Y	Y	
Use a societal benefits charge on electric bills to establish a fund for energy efficiency programs & renewable energy technologies.	Y		Y					Y	Y			Y		Y
Shared Savings Program – energy svc companies give energy conservation products/equip. to businesses in exchange for savings on their energy bills.									Y					
Establish a n energy efficiency partnership & info. clearinghouse											Y	Y		
Promote high efficiency appliances & improve product information for consumers.	Y	Y	Y	Y	Y		Y	Y	Y		Y	Y	Y	Y
(b) Industrial														
Provide low interest loans to business to encourage purchasing of CO2 reducing tech.	~Y	Y						Y	Y			Y		
Early Action credit														Y
Promote auditing and benchmarking for small & mid sized industries	Y		Y			Y			Y			Y		
Promote energy efficiency for heat recovery, containment, space conditioning, boilers, steam, air compressors, motors & lighting.	Y	Y	Y	Y	Y		Y	Y	Y		Y	Y	Y	Y
Promote fuel switching		Y	Y			Y		Y	Y			Y		Y
Implement low carbon technologies & cogeneration	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	
Developing & integrating renewable power industry – Renewable Portfolio Standard		Y	Y		Y		Y	Y	Y			Y		Y
Emissions Trading						Y			Y	Y		Y		
Training workshops on energy efficiency technologies	Y	Y												Y
2. Transportation														
Implement the use of HOV lanes and limited speed limits (55 mph)		Y	Y					Y			Y	Y	Y	Y
Stringent Vehicle emissions inspection and maintenance programs	Y	Y	Y					Y		Y	Y	Y	Y	

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Increase fuel efficiency of motor vehicles (increase CAFÉ stds)		Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	
Reduce VMT via parking regulations & controls (i.e. Park & Ride Lots, parking fees)	Y					Y	Y		Y		Y	Y	Y	
*Promote pricing measures that Reduce VMTs (fuel tax, VMT tax, user fees)		Y	Y	Y		Y	Y	Y	Y	Y		Y	Y	Y
Encourage telecommuting to reduce VMTs		Y		Y		Y		Y			Y	Y	Y	Y
* Develop policies that change land use patterns	Y	Y	Y		Y	Y		Y	Y		Y	Y	Y	
Initiate a pilot project of “travel blending” to study & reduce car use for a group of households in the same area (along the same major highway)								Y				Y		
Promote non motorized modes of transp. (bikeways, walkways)	Y		Y	Y			Y	Y		Y		Y	Y	
Promote & Improve Public Transit	Y	Y	Y	Y		Y	Y	Y		Y		Y	Y	
Education Programs on Fuel Conservation	Y?		Y		Y	Y	Y		Y				Y	
* Internalize costs of transportation via transp. energy taxation		Y	Y	Y		Y	Y	Y		Y	Y	Y	Y	
Introduce reformulated gasoline requirements	Y	Y	Y	Y				Y			Y		Y	
* Use statewide mandates and market mechanisms to encourage rapid use of AFV		Y	Y			Y		Y	Y	Y	Y	Y	Y	Y
Expanded use & development of low/ alternative emission vehicles & fuels. (Use incentives like fuel subsidies & vehicle purchase incentives or FEEBATES.)	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	
Increase use of renewable energy sources (methanol, ethanol, NG, hydrogen, etc.)	Y	Y	Y	Y		Y		Y		Y		Y	Y	Y
3. Waste Management														
(a) Recycling														
Landfill gas recycling (methane flaring or power generation)	Y		Y		Y		Y	Y	Y	Y	Y	Y	Y	Y
Reduction of waste in wood processing and increase paper and wood recycling	Y		Y	Y	Y			Y	Y		Y	Y	Y	
Reduce landfill waste (recycle organic matter, implement volume-based fee program, mandatory curbside recycling, etc)	Y		Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	
(b) Pollution Prevention														
4. Land Use														
Reduce Nitrogen fertilizer applications on farmland						Y	Y		Y	Y	Y			
Livestock management for CH4 emissions reductions (recovery /collection of CH4)		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
*Carbon Sequestration	Y				Y	Y	Y	Y		Y	Y			
Encourage greenspace/forest conservation	Y		Y	Y	Y	Y	Y	Y						
Support Smart Growth Initiatives	Y	Y	Y		Y			Y	Y		Y			
Afforestation of marginal cropland, pasture & riparian zones		Y	Y	Y	Y	Y		Y				Y	Y	
Tree Planting in Urban/Suburban areas	Y	Y	Y	Y	Y		Y	Y	Y					
Increase Land Acquisition	Y								Y					
Develop Agroforestry/Biomass energy programs		Y	Y	Y	Y	Y		Y						
5. Education														
Print/mass media to reinforce message to public				Y	Y		Y	Y	Y			Y		Y
Research public beliefs, attitudes and behaviors								Y						
Education in primary & secondary schools	Y			Y	Y			Y						
State support to publicize & extend successful voluntary indus.& govern. initiatives		Y			Y			Y				Y		Y
Continue to research & inventory GHG emiss & study impact/progress of action plan					Y	Y								Y

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Laundry List of Activities by State and Sector:

Vermont organizes their Action Plan into five major sections for consideration of reducing GHG:

1. Energy Sources and Supply, 2. Transportation, 3. Buildings and Equipment, 4. Affordability and 5. Government Energy Use and Energy Policy

They also define Energy Use by sectors (Transportation, Industrial, Commercial and Residential) and Energy use by “end use”

The institutional structures that frame much of this energy use include: 1. Regional Planning commissions, Vermont Department of Public Service, Vermont Agency of Transportation, Vermont Agency of Natural Resources, NEPOOL.

They focus much of their recommendations for improvement in the idea of internalizing external costs associated with energy prices, increasing energy efficiency and renewable energy resources, and increased competition in the electric utility industry

Recommended Strategies and policies:

Promote Sustainable Use of Wood and Wind Energy:

Promote clean efficient wood burning with new stoves

Promote commercial and industrial use of wood energy

Promote renewable resources and new technologies with a renewable portfolio standard

Promote use of Solar Energy

Shift clocks toward a solar day

Increase solar lighting and heating applications

Increase solar water heating installations

Promote photovoltaics

New Jersey

NJ breaks up their Action plan by Recommended strategies: 1. Energy Conservation, 2. Innovative Technologies, 3. Pollution Prevention, 4. Waste Management, 5. Natural Resources, 6. Open Space

Most of their GHG emissions come from fossil fuel combustion to produce energy for 1. Heating, 2. Cooling, 3. Electricity and 4. Transportation.

NJ does not specifically discuss in their action plan any of the institutional frameworks in place that are tackling all of the different GHG reduction strategies.

It mentions working with the Dept. of transportation and the Dept. of Energy and the EPA – the NJDEP was the primary agency on the development of the plan.

California

California’s institutional structures involved with the reduction of GHG include – the California Energy Commission along with the California Public Utilities commission (an independent system operator). The state switched to a deregulated market based system for electricity production. The three major producers PG&E, SCE, SDG&E distribute energy to smaller municipal, local and private companies. A power exchange auction brokers power to different companies.

Delaware:

This Action Plan divides strategies/policies by 6 sectors – Industrial, residential, commercial, utility, transportation, waste sector, forest sinks. They also ran a model under different reduction scenario for each sector. They do not include in their plan on institutional frameworks for energy production and usage. The state focuses on participation in existing Federal programs as well as improving energy efficiency for heating, lighting and appliances, HVAC.

Appendix B: Glossary of Terms

Alternative Energy Sources: Non-fossil fuel based energy sources such as ethanol, solar, hydro, and geothermal. Commonly refers to renewable energy sources.

Alternative fueled vehicles: Vehicles with a non-conventional energy source such as biodiesel, electricity, ethanol, hydrogen, methanol, and natural gas. These fuels often reduce air pollution and greenhouse gas emissions due to lower emission of ozone precursors and carbon dioxide.

Alternative transportation: Mode of transportation other than automobiles that allows transit which does not contribute to congestion. Alternative transportation includes pedestrian travel, bicycles, busses, and trains. Helps reduce air pollution and greenhouse gas emissions by reducing the amount of fossil fuels consumed for travel.

Carbon credit registry: A way to account for reductions in greenhouse gas emissions that are independently verified. The carbon credit registry can be extended to include all greenhouse gasses by converting to a single unit of Metric Tons of Carbon Equivalent (MTCE) that allows comparison of different gasses. This allows entities to take credit for reductions against possible future greenhouse gas emissions regulations.

Carbon sequestration: The uptake and storage of carbon by vegetation or oceans. Vegetation, for example, absorbs carbon dioxide and releases oxygen during photosynthesis. Fossil fuels were at one time biomass and continue to store the carbon until burned.

DSM (Demand-Side Management)
-- Programs that are often utility sponsored which evaluate, plan, and implement efficiency improvements through changes in the amount or timing of customers' energy use. This often entails energy audits, weatherization, and installation of efficient lighting.

Energy efficiency: Using less energy/electricity to perform the same function. Can be applied to any activity that requires the use of energy such as transportation, heating buildings, lighting, industrial processes, and other similar activities.

Feebates: A feebate is a revenue neutral strategy that imposes a fee on inefficient technologies and rebates those fees to cleaner, more efficient technologies. An example would be a tax on SUV's at the time of registration that would fund a rebate at the time of registration for fuel efficient vehicles.

Fossil fuel: A general term for buried combustible geologic deposits of organic materials, formed from decayed plants and animals that have been converted to crude oil, coal, natural gas, or heavy oils by exposure to heat and pressure in the earth's crust over hundreds of millions of years.

Fuel cells -- A fuel cell is similar to a battery in design with a positive (cathode) and negative (anode) terminal for electrical current. Fuel cells differ in that they are open systems that require the input of energy to generate current from a fuel source, whereas batteries are a closed system that store potential energy from a previous charge. Fuel cells produce electricity much more efficiently (80 % efficient) than a standard combustion engine (30% efficient). This is because fuel cells use technology, such as a proton membrane, to separate hydrogen from a fuel source instead of burning the fuel - this means less energy is wasted as heat. The hydrogen releases electrons to generate electricity and then combines with oxygen to form water as a byproduct. The primary fuel cell technologies under development are:

- Phosphoric Acid Fuel Cells
- Proton-Exchange Membrane Fuel Cells
- Solid Oxide Fuel Cells
- Direct-Methanol Fuel Cells
- Molten Carbonate Fuel Cells
- Alkaline Fuel Cells
- Regenerative or Reversible Fuel Cells

Greenhouse gases: Visible light from the sun warms the earth. Heat from the surface then radiates through the atmosphere as infrared radiation. Greenhouse gasses are opaque to this infrared radiation and therefore absorb the radiation and heat the atmosphere. The addition of greenhouse gasses to the atmosphere increases the amount of outgoing infrared radiation that is absorbed, further warming the atmosphere. Greenhouse gasses include carbon

dioxide, methane, nitrous oxide, flourocarbons, sulfur hexaflouride, ozone, and water vapor.

Hybrid vehicles: Hybrid electric vehicles (HEVs) combine the internal combustion engine of a conventional vehicle with the battery and electric motor of an electric vehicle. The result is a vehicle with twice the fuel economy of a conventional vehicle. This achieved by recycling the kinetic energy of the vehicle through regenerative braking and transmission systems that generate electricity to recharge batteries for the electric motor instead of wasting energy from deceleration as heat. The inherent flexibility of HEVs allows them to be used in a wide range of applications, from personal transportation to commercial hauling.

Landfill Regeneration: The most important greenhouse gas emitted from landfills is methane (CH_4) from anaerobic (without oxygen) decomposition of organic waste in landfills. Instead of allowing landfill methane to escape into the air, the gas can be flared or burned to generate electricity. Flaring is simply burning the methane without using the heat - this reduces the impact of the methane by about 95% since it is a very powerful greenhouse gas, even though carbon dioxide is released. Using the heat from the flaring to generate electricity reduces the impact of methane by an additional 5% by displacing the carbon dioxide emissions from other fossil fuels that would have otherwise been burned to generate that electricity. Both flaring and burning to generate electricity helps reduce odors and other hazards associated with landfill gas emissions.

Mass transit: A system of multi-occupancy vehicles used generally for urban transportation. Minimizes the number of single-occupancy vehicles (generally internal combustion vehicles) in regular use – the result is almost always less air pollution and greenhouse gas emissions.

Mill tax: A common utility monetary measure equal to one-thousandth of a dollar or a tenth of a cent. The mill tax, placed on each kWh of electricity sold, is used in some states to fund demand side management programs (DSM programs). DSM (see above) programs are utility-sponsored programs to influence the *amount or timing* of customers' energy usage. The Rhode Island Mill tax is 2.3 mills, or 0.0023 cents per kWh, which generates approximately \$20,000,000 annually.

Renewable resources: Renewable energy resources, commonly referred to as green energy, are naturally replenishable, but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Some (such as geothermal and biomass) may be stock-limited in that stocks are depleted by use, but on a time scale of decades, or perhaps centuries, they can likely be replenished. Renewable energy resources include: biomass, hydro, geothermal, solar and wind. In the future they could also include the use of ocean thermal, wave, and tidal action technologies.

“Smart Growth”: At the most basic level, smart growth aims to prevent the adverse environmental, social, and

economic impacts of unplanned development in communities. Smart growth is a term that also pertains to energy efficient development patterns. It can take the form of land use controls that draw a ring around an urban area and direct all future growth inward (i.e., “urban growth boundaries” or UGBs), limiting state investments to areas with existing assets and infrastructure, or providing financial incentives to encourage development that takes advantage of existing community assets (i.e., “priority funding areas”). Smart growth can include mandating or encouraging “new urbanism” planning principles where development is done on a mixed-use basis (e.g., residential, commercial, etc. mixed together). Development is based on a pedestrian scale, with buildings close to each other, accessible public transit, and ample sidewalks and bikeways; all to encourage people to use their cars less often.

Telecommuting: Virtual commute via telephone or internet that precludes the need to physically travel to a destination. This strategy has applications in almost every organization where virtual meeting can be substituted for physical meeting, thereby reducing greenhouse gas emissions from transportation.

VMT: Vehicle miles traveled.

Volatile Organic Compounds (VOCs): VOCs are organic (carbon-based) compounds used for a variety of industrial and manufacturing purposes that vaporize at ambient atmospheric temperature and pressure. Examples of VOCs are

benzene, toluene, and xylenes. VOCs are precursors that form ozone, a greenhouse gas.

Weatherizing: Describes the general process of minimizing the loss of heat and energy from a building structure. There are many different ways to weatherize a building. The weatherization process can include: **a)** replacing windows to minimize loss of heat during winter and the escape of cool air during summer **b)** replacing old insulation with new high-technology insulation, **c)** caulking and weather-stripping to reduce air infiltration and exfiltration in/out of a building.